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ABSTRACT

This guide is one of a set of 10 science guides, each covering a separate grade in Manitoba, together covering kindergarten through grade 9. The guides have been designed to provide a framework for building scientific concepts and developing the learning of process skills. They replace an earlier set of guides dated 1979. Each guide is essentially the same through the first 16 pages, after which the core units vary appropriately for each academic level. Three themes and units within those themes which are carried through the K-4 program include: (1) environmental interdependency and interaction--living organisms in the environment (grade 2); (2) matter and energy--flotation-a property of matter (grade 2); and (3) earth, time and space--light and shadows/measuring time, objects and position (grade 2). (AA) (KR)

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Manitoba Education and Training

1991

science: grade 2

interim guide

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science: grade 2

interim guide

THIS GUIDE IS SUBJECT TO REVISION ON THE BASIS OF INFORMATION RECEIVED FROM SCHOOLS. IT IS EXPECTED THAT MODIFICATIONS WILL NOT BE MADE IN THE DESIGN OF THE PROGRAM. RATHER, CHANGES MAY BE MADE IN AREAS CONCERNING STRATEGIES AND IMPLEMENTATION.

manitoba education and training

1991

ISBN 0-7711-1007-3

This guide has been prepared by Manitoba Education and Training to meet the needs of grade 2 students. This guide has been revised on the basis of feedback from teachers during the period of 1988-89. It has been designed to articulate with the new K-1 and 3-9 Science guides and to provide a framework for building scientific concepts and developing the learning of process skills. This guide may be used in September, 1991, in place of the previous (1979) guide.

The Department of Education and Training wishes to acknowledge the contributions of the following members who constituted the committees responsible for the development of this guide.

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OBJECTIVES OF THE CURRICULUM

AIMS

"Science is a search for understanding" through a systematic and cumulative exploration of the natural phenomena of the universe.[1]

Teachers should strive for balance in the science program, and should especially try to make processes development at least as important as content.

The K-4 science program includes the following:

- promoting of attitudes as part of scientific literacy, including:
  - curiosity to explore, ask questions, actively investigate;
  - inventiveness in generating new ideas, using equipment constructively, suggesting new experiments;
  - critical thinking to justify conclusions or predictions and changing ideas in response to evidence or logical reasons;
  - persistence in maintaining an active interest in a problem.
- understanding and use of scientific processes.
- understanding and applying knowledge to practical situations.
- understanding the interactions of science, technology and society by applying them to their environment.

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[1] H. Grunau, Faculty of Education, University of Manitoba.

Science education provides experiences that are relevant to children on an immediate and personal level, developing attitudes, skills and knowledge for use today and in the future.

Exploration of the above areas, and helping children to apply the ideas in practical situations, provide for use of higher level thinking processes, which in turn provide for self-motivated, independent, concerned participants in society.

ROLE OF SCIENCE IN GENERAL EDUCATION

Children initially examine their environment through concrete experiences within a broad range of interests. One of the important functions science shares with other areas of study is the development of basic processes of classifying, measuring, using space-time relationships, inferring and predicting, and applying these processes to the world around them.

The young child lives in and views an integrated world and this leads to many opportunities for integrating subject areas.

Through interaction with materials in simple group activities, children are able to develop listening, reasoning, and group participation skills. In centre based activities, small groups and individuals develop written communication, graphing and measurement skills, independence and confidence. Children need opportunities to concretely explore and understand relationships in this multi-dimensional world. Science can "spark" interest in all areas of study. An example of the Kindergarten science concept "plants require certain things to grow" is outlined to show one way of integrating objectives from other subject areas i.e., the use of centres.

VARIETY AND NATURE OF CHILDREN

The emphasis of psychologists such as Piaget, Bruner, Ausubel, and Gagne is placed on experience with concrete materials and the child's need to be involved in actively structuring his or her learning. According to Piaget, children pass through an ordered series of developmental stages, believed to be controlled by the maturation of the brain and the nature of a child's experience. These stages aren't limiting, as all children have different experiences in different areas.

Appropriate activities for Piaget's various stages are:

2 to 6 years - Pre-Operational

Being able to manipulate and carry out physically the actions he/she may not be able to carry out mentally. Exploration and experiences of trying things out to see the result enables them to link cause and effect. An activity is repeated several times, if desirable.

7-12 years - Concrete Operational

Exploring a wide range of problems in real situations and gradually coming to see patterns. Planning and carrying out investigations or methods of problem solving which he/she has devised; discussing results and learning from errors about the variables which should be controlled. Putting problems in concrete terms where doing can support thinking.

13-15 years - Formal Operational

Drawing conclusions from previous learning and applying principles to new problems. Testing ideas by planning experiments which control all the necessary variables. Developing abstract ideas about properties of materials; devising and using theoretical models for predicting and explaining.

Taking this into account, the science program must be experience-based and activity-centered. Concrete experiences are essential for the pre-operational and concrete-operational stages in order to meet changing needs, abilities, interests and learning styles of the children. The science program must give children time, space, and encouragement to explore science and consolidate learning inside and outside the classroom.

MISCONCEPTIONS IN SCIENCE

Misconceptions represent complete systems of explanations which are conceptually wrong. They are usually personal and constructed from one's experiences. K-4 children harbour many misconceptions in science, partly due to their limited experiences and stage of mental development. These misconceptions may be adjusted by teaching science through a wide usage of concrete and relevant experiences, and adequate, appropriate discussions of findings in a non-threatening environment. Some examples of misconceptions are:

1. that an object will float in shallow water but will sink in deep water;

2. that because plants need sun, food and water, the plants will flourish if you give them direct 24 hour sunlight, and as much water and fertilizer as possible;

3. that the metamorphosis of mealworms will result in only more mealworns with the misconception expressed by the question: Who put the beetle in the bottle?

Teachers of science who want to modify their children's conceptual framework need to challenge the children's alternative conception. Some guidelines for teachers are:

. ask children for their ideas, respect the ideas and explanation offered;

. guide the students into developing experiments or experiences that will allow them to test their ideas;

. encourage the children to discuss and resolve the discrepancies between their initial predictions and the new evidence;

. always listen to see whether students have adadjusted their conceptual framework after the experiment or experience.

GIRLS IN SCIENCE

Research shows that girls are biased against areas of physical science through home, media and school experiences at as early an age as six years. Girls have already developed opinions about appropriate behaviours and occupations for one or the other sex by this age.

"A girl might aspire to be a lawyer but expect to be a typist in a law office; ....she might aspire to be a doctor but expect to be a nurse."[2]

Teachers must:

. consciously model enthusiasm and involvement in science to motivate children to participate and become involved in science;

. offer bias-free resources (those that give equal consideration to both sexes in career and lifestyle portrayal);

. have equal expectations for boys and girls (studies have shown that boys receive considerably more teacher feedback, occupy more physical space, are more critical of girls and of each other, and generally assume the leadership role in a mixed group);

. encourage both boys and girls in planning, recording, setting up experiments, using equipment and other learning opportunities;

. encourage projects which recognize skills and interests of both sexes and discourage put-downers or devaluing of "female" interests by male students.

[2] "Who Turns the Wheel?", Science Council of Canada, January, 1982, p. 82.

PROGRAM IMPLEMENTATION

The school administrators have an important leadership role in science program implementation. This role includes the following directions or activities:

- encouraging a shared management of implementation for the science program by providing opportunities for cooperative planning.
- monitoring the degree of implementation and the needs of staff.
- determining the implications of the curriculum for staff training and facilities.
- providing easy access to the materials and facilities needed for the program. This will include the provision of sufficient funds which would be used to purchase necessary equipment and materials as the need arises.

Some implications of the science program for implementation into the school include:

- like in the previous curriculum, the new program emphasizes the development of science processes and concepts. The use of activities to develop these processes and concepts will affect teaching methodology and evaluation methods.
- the K-4 science program has introduced new segments within the program: Flotation: A Property of Matter, life cycles, a consolidation of the previous K-1 program, application of science and Implementation may require specific work with teachers in order to increase their knowledge and teaching methodology base for these units.
- the science program suggests some ways to integrate some mathematical and language arts skills into the structure of some topics. Developing additional units whereby mathematics and language skills are an outcome of science units and activities may be required.

Evaluating the effectiveness of the science program consists of judging its worth on the basis of valid information about how well the achieved curriculum meets the objectives of the intended curriculum. Many sources of data should be searched to provide a basis for the evaluation, such as:

- evaluation of student achievement;
- analysis of the methods of evaluation;
- teaching strategies and emphases upon program goals.

Additional sources of information about program evaluation are:

1. Mechling, Kenneth R., "Taking Charge: How Principals can Improve School Science Programs, "Principal, January 1983, pp. 16-21.
2. Mechling, Kenneth R. & Oliver, Donna L., "Activities, Not Textbooks: What Research Says About Science Programs.", Principal, March 1983, pp. 41-43.

3. Mechling, Kenneth R. and Donna L., Promoting Science Among Elementary Principals: Handbook I-IV, National Science Teachers' Association, 1742 Conneticut Avenue, N. W., Washington, D.C., 1983.

COMPUTERS IN SCIENCE

Computers are a recent addition to the learning environment. They offer extensions and support for science learnings. Computers are not a primary means of delivering science education or a replacement for direct investigations. However, they can enrich the science program and provide individual and practice work in a number of ways. These include:

- developing an awareness of the role of complex technologies in society.
- simulations;
- problem solving exercises.

Computers are a way of life in the future for children.

TIME ALLOTMENT FOR THE SCIENCE PROGRAM

Recommended time allotments for K-3 science are 15 minutes daily or 75 minutes weekly and for grades 4-6 are 30 minutes daily or 150 minutes weekly. Time allocations for each unit can vary but teachers should ensure that students are given sufficient time to cover the entire program for any given year.

ENRICHMENT ACTIVITIES

The activities included in the K-4 program provide learning experiences that help students understand and interpret the world in which they live. The activities which appear under the heading of enrichment are intended as extensions to the regular program. These activities have been selected in order to allow students to explore some areas at greater depth.

STUDENT EVALUATION

The general purposes of student evaluation are to provide:

- students with an understanding of their development and needs relative to the program;
- teachers with a basis for planning necessary changes in teaching strategies and the curriculum;
- information for parents and administrators.

Thus, evaluation should be related to program objectives, and in the K-4 science program, it should relate to science processes and attitudes in addition to content. Further, evaluation must be continuous and use a variety of approaches.

Informal observation techniques whereby teachers observe individual and group interactions in an activity can help to determine needed skill development of students and techniques which can be used to improve their skills.

Formal techniques include achievement and performance tests, checklists of processes, attitudes, and manipulative skills and the examination of products such as reports or projects. Although achievement tests (pencil and paper variety) are generally considered to evaluate content most effectively, other objectives of the program such as science processes and attitudes can be evaluated by written and performance items, checklists and other means.

SAMPLE EVALUATION TECHNIQUES

A. Processes Checklist

Monitoring student achievement in science processes may be helped by observing student behaviours in applying the processes. The student should be able to carry out the processes noted in the objectives in each science unit in the curriculum, at the appropriate grade level. A checklist from these objectives can be made, the concepts are taught, and then the process involved can be checked off for those students who show mastery. Samples of some student behaviours are:

Process	Behaviour
Observing	. Identifies properties of an object with and without sight; uses a variety of senses.
	. Selects objects according to special properties.
	. Identifies changes in an object and parts of a system.
	. Places a greater emphasis upon quantitative observation (estimating, measuring).
	. Describes motion of an object relative to a reference point.

Communicating	. Reads and constructs bar graphs, simple tables, and charts. . Interprets accurately information and instructions presented orally, in writing, and in graphic or pictorial form. . Reports information concerning an investigation; e.g., states the problem, records the results, and reaches a conclusion.

B. Scientific Attitude Checklist

Attitude	Behaviour
Questioning of All Things	. Shows curiosity with objectivity and open mindedness.
Searching for Data and Their Interpretation	. Looks for support for their ideas.
Demanding Verification	. Seeks data and information to validate observations or explanations. . Questions conclusion based on incomplete data.
Respecting Logic	. Modifies views in the face of new evidence . Shows respect for the ideas of others.

C. Performance Items

These items may be used individually or in a group (station) setting to test process and manipulative skills at the grade 3 level. For example:

Birds

Purpose: to test observing/classifying, interpreting skills.

Procedure: Pictures of two birds are provided and children are asked to see what is different about them and how they are different. Use only observable differences, i.e. colour/pattern, size/shape, environment.

Marbles in Tubes

Purpose: to test observing, inferring, interpreting data, explaining physical phenomena, safety/manipulative skills.

Procedure: Three covered tubes in upright positions, each containing liquids of different densities (i.e., water, vegetable oil, methyl alcohol) and a marble. Tell students that the marbles are all the same size and weight. have students examine the tubes and turn them upside down. Ask students to write down three things they observe and to propose a reason for the marbles taking different times to fall.

SAFETY AND SCIENCE[3],[4]

The K-4 curriculum contains few safety hazards to children. Teachers should establish proper classroom behaviour, conducive to safe operation. Common sense is the best guide to follow in the area of safety. Manageable group size and a well-planned lesson will allow students to work without confusion. By showing concern for safety, the teacher can help the students develop a positive attitude in regard to safety.

General Safety Guidelines

- At the beginning of the science class, remind the students about the applicable safety precautions they must take during the lesson.
- Give clear, complete directions before allowing the students to begin any activity.
- Instruct students not to taste or touch substances or materials without permission.
- Stress the importance of not touching one's eyes, ears and mouth while working with plants, animals and chemicals.
- Allow time for clean-up and proper storage of materials.
- Closely supervise your students at all times.
- Familiarize students with first aid, fire drill and other emergency procedures.

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[3] "Safety in Science." Department of Education, 1982.

[4] "Safety in the Elementary Science Classroom," National Science Teachers' Association, 1742 Connecticut Avenue, N.W., Washington, D.C., 20009.

Some tips on animals and plants are:

Animals

- Check for student allergies.
- Obtain animals only from a reputable dealer.
- Keep in suitably sized enclosures.
- If animal is in poor health, remove it from the room until a veterinarian has been consulted.
- Always wash hands after handling the animal.
- Keep an animal only for as long as it is a meaningful part of a classroom program.

Plants

- Check for student allergies.
- Be aware that parts of some plants are poisonous, i.e. leaves - rhubarb, dieffenbachia;
  sap - poinsetta.
  seeds - castor beans

ATTITUDES AND VALUES

One of the greatest achievements of science is to have developed scientific methods that work almost independently of the people who are conducting the scientific investigations. Thus, children learning science must also learn many attitudes toward science such as:

- objectivity;
- open-mindedness;
- fairness;
- accuracy;
- thoroughness;
- perseverance;
- curiosity;
- creativity;
- risk taking.

The rudiments of these scientific attitudes can be learned very early in school, based on a gradual understanding, rather than direct teaching.

SCIENCE, TECHNOLOGY AND SOCIETY

School science is sometimes understood by students to be an end in itself. A science, technology and society (STS) emphasis attempts to help students understand the applications of science and how this relates to the world around them, making science much more relevant.

For the K-4 level, the major STS emphasis is the child's home, community environment; expanding to include cities, provinces and beyond.

The methods for incorporating STS are varied. One approach is to develop a science concept first, followed by applications, i.e. introduce the concept of heat insulators and later apply the concept by testing house insulation or designing ice-cube insulators. Another approach is to introduce the application first, and conclude with the basic science concept, i.e., Discuss how we keep our house warm in winter, or why do people replace old windows. This is the application of the science first and through testing materials, the students will conclude with the basic concepts of insulators.

Overall, it is suggested that STS goals should receive some 15-20% of the total emphasis. Some units and/or parts of units in the curriculum lend themselves more to STS activities and discussion than others. This guide marks some STS objectives/ activities with two asterisks (**) beside it. Teachers should feel free to find or develop their own examples.

ENVIRONMENTAL EDUCATION

Concerns for the environment have become so important that teachers need to be aware of imparting these values to children by example as well as by formal teaching. Such environmental values include:

- responsibility for living organisms;
- consideration for others;
- interaction with the environment in a responsible manner;
- concern and care for the environment.

Values taught through science education transfer well to life outside the classroom, developing environmentally alert individuals capable of making well-reasoned interpretations and motivated to taking responsibility for their decisions throughout life.

SUSTAINABLE DEVELOPMENT STRATEGIES

Sustainable development is the process of maintaining our natural heritage. It is important that students are made aware of the need for judicial use and management of our natural resources. The students are the stakeholders. They need to be informed about environmental concerns and the economic devastation which occurs due to a lack of environmental protection.

A Sustainable development strategies (SDS) emphasis in the science program will allow students to identify the areas in which environmental damage is taking place and to explore methods by which the environment can be protected. This SDS emphasis begins in kindergarten and continues throughout the entire science curriculum.

Some units lend themselves more to SDS activities and discussions than others. Teachers are encouraged to develop and foster SDS awareness whenever the opportunity arises.

This guide identifies the SDS related objectives with three asterisks(***) beside them.

PROCESS DEVELOPMENT

Processes are intellectual skills, developed and used both in science and other areas of study. When children experiment with materials and examine ideas both processes and concepts are being developed and used. Observation and classification skills are important to the development of more complex processes such as interpreting data and are therefore classified as basic processes. These basic processes should begin to develop from early experiences. Experimenting and controlling variables are termed integrated processes and can usually be more effectively learned by children in the late concrete and formal operational states. Each process, in turn, consists of a series of levels of difficulty, i.e., the process of observation varies from the skill of describing an object in terms of a single property to identifying the object in terms of its many properties. The basic processes are gradually developed from early childhood through grade four. The integrated processes are stressed at higher levels, but all processes can be informally introduced to young children through simple investigative situations presented and directed by the teacher.

It should be noted that many of the main processes often include other activities that reflect various aspects of the process:

- observing includes identifying;
- classifying includes comparing and ordering:
- communicating includes describing and graphing.

Observation

Observing is one of the basic process skills of science. It involves obtaining information about objects, situations or events using the five senses. Observation may be qualitative or quantitative in nature. Observing provides both a basis for new inferences or hypotheses and a tool for testing existing inferences and hypotheses.

Measurement

Measuring is the process of determining the dimensions or quantity of an object or event. It usually involves comparison of size, volume, mass, temperature and time using non-standard/standard units.

Classifying

This process is the grouping of objects, concepts, or events on the basis of some observable properties in order to show similarities and/or interrelationships.

Inferring

Inferring means suggesting more about a set of conditions than is observed. Inferences are based upon observed data and past experience. Inferences may evolve from both direct and indirect evidence and are modified on the basis of new evidence. An example of inference: "to infer the identity of objects on the basis of observation of shadows".

Communicating Data

This is a process that occurs between the observation stage and the interpretation stage. It usually involves the organization of "rough" data into a more compact and meaningful way (ordering, comparing), depicting the data pictorially or graphically, and processing data mathematically (averaging, finding slopes) in order to facilitate interpretations.

Predicting

Predicting is a forecast about future events based on previously obtained data. Predictions can be made on the basis of ordered data or extrapolation beyond an observed pattern of events. An example of prediction: "to predict the consequences of changes in an animal habitat".

Hypothesizing

Hypothesizing is an educated guess about an expected relationship between two variables in an attempt to explain a cause and effect relationship. The hypothesis should be testable.

Recognizing and Identifying a Problem

This process involves recognizing and focusing on a problem that can be investigated, making assumptions about possible variables, and the ability to narrow down the question under investigation in order to work towards a solution.

Identifying and Controlling Variables

This process involves deciding which variables will influence the outcome of an experiment or event and deliberately controlling all recognized variables in a systematic manner. This combination of relationships (system) consists of a manipulated (independent) variable which is changed in a systematic way, corresponding changes in an observed responding (dependent) variable and all other variables are held constant (controlled). An example is a pendulum system where the time of swing (responding) is affected by the pendulum length (manipulated) and other variables such as mass of the bob and arc of the swing are kept constant.

Designing an Experiment

Experimenting is a cause and effect test between two variables. All processes may be involved. This may begin with setting a problem to be solved identifying a variable to be controlled, making operational definitions, devising the test to be carried out and finally to follow the prescribed procedure.

Interpreting Data

Interpreting is the process by which sense is made out of the observations in the form of inferences, generalizations or explanations. Thus, selecting data which supports inferences, identifying a general trend, and stating a conclusion or relationship are integral parts of this process. An example is: "state the average growth rate of bean plants."

Operationally Define

This is a process whereby objects or events are defined in a way which can be tested or observed such as: "When I join copper wires, a bulb and a dry cell in this way, a bulb will light up.

Using Space/Time Relationship

All objects occupy points in space at a given point in time. This process concerns spatial relationships and the ability to describe such things as shape, symmetry, direction, position and spatial arrangement, and speed.

PROBLEM SOLVING

Problem solving is a familiar teaching/learning approach which lends itself to science teaching. Problem solving includes:

- recognizing problems;
- discussing or thinking about solving them;
- trying out one solution;
- assessing the effectiveness of the solution;
- possibly modifying the solution in the light of experience.

The approach can be used to help children understand the world of human endeavours through practical problem-solving activities, involving using and discovering science skills in conjunction with "design and make" activities.

Problem solving exercises can vary considerably in content and in the processes and strategies employed:

- exercises which are of a technological nature where children are asked to design, construct, test and evaluate a system;

- exercises designed to carry out a scientific investigation;

- decision making exercises where children discuss a problem and come up with their own solution (role playing, games, simulations).

Preferences should be given to activities that involve a problem-solving approach and which:

- encourage creativity and inventiveness in designing and making 3-dimensional models which achieve a given task;

- cause students to learn or reinforce concepts relating to energy, materials and their properties, structures, forces, speed, measurement, accuracy, stability and control;

- give opportunities to develop manipulative skills with simple tools and range of materials;

- develop communication skills within and between teams and adults including drawing and display of ideas and achievements;

- involve some element of planning and organization.

Problem solving should be a regular part of the science program. This guide marks problem-solving objectives/activities with one asterisk (*) beside it.

SCOPE AND SEQUENCE

Process Development: When a process is introduced at an early stage, it should be developed and maintained in subsequent years.

PROCESS/GRADE	K	1	2	3	4
Observing	I	D	D	E	E
Measuring	I	I	D	D	E
Classifying	I	I	D	E	E
Inferring	I	I	D	E	E
Communicating	I	I	D	D	E
Predicting	I	I	D	D	E
Recognizing a Problem	I	I	D	D	E
Controlling Variables			I	I	D
Hypothesizing				I	D
Interpreting Data			I	I	D
Operationally Define			I	D	D
Design Experiments			I	I	I

Note:

I - Introduce processes using primarily teacher input.
D - Develop processes with less teacher input.
E - Extend processes to become more student controlled and directed.

ATTITUDE DEVELOPMENT

When an attitude is introduced at an early stage, it should be developed and maintained in subsequent years.

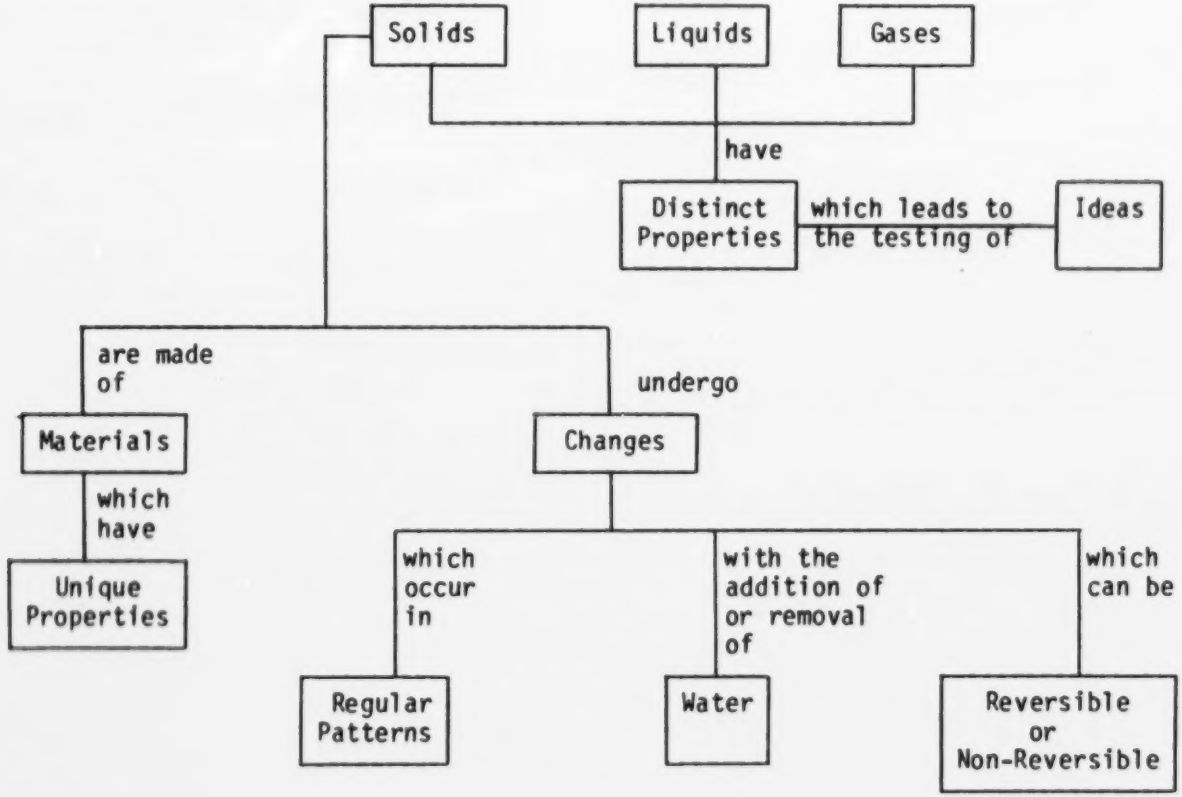
ATTITUDE/GRADE	INTRODUCTORY GRADE
Appreciate all living things.	K
Be committed to good animal care.	1
Be aware that animals can cause allergic reactions.	1
Value differences and similarities among humans.	1
Appreciate the adaptive value of some animal behaviours.	3
Recognize the need for safety in all activities.	K
Recognize the need for standard units and references.	1
Appreciate the need for verification.	1
Develop curiosity about natural events.	2
Recognize the need for accuracy in measuring.	2
Recognize that predictions can be made as a bais of valid evidence.	2
Seek plausible hypotheses to interpret findings.	4
Recognize the need for an empirical test as a basis for judging hypotheses.	4
Respect the importance, order, and beauty of the environment.	2
Recognize the need for man's care of the environment.	2
Recognize the importance of uses of different energy sources.	3
Develop an interest in learning about the universe.	3
Recognize the need to control sound in the environment.	4
Appreciate the technology of communication.	4
Appreciate the technology of electricity.	4
Appreciate the power of geological forces.	4
Recognize the dependence of man upon geological forces.	4
Recognize the importance of water as a resource.	4
Recognize the need to control and handle water wisely.	4

General Program Overview

THEME	K	1	2	3	4
Inter-Dependency and Interaction	Living and Non-Living Organisms	Animals are Living Organisms --- People are Living Organisms	Living Organisms in the Environment	Life Cycles	Population Interaction
Matter and Energy	Properties of Objects	Properties of Matter	Flotation: A Property of Matter	Energy, Heat and Temperature --- Changes in Matter	Electricity --- Structures --- Sound
Earth, Time and Space	Size, Position and Time	Comparing and Measuring Events	Light and Shadows --- Measuring Time, Objects and Position	Sun, Earth and Moon --- Air and Air Pressure	Water and Land

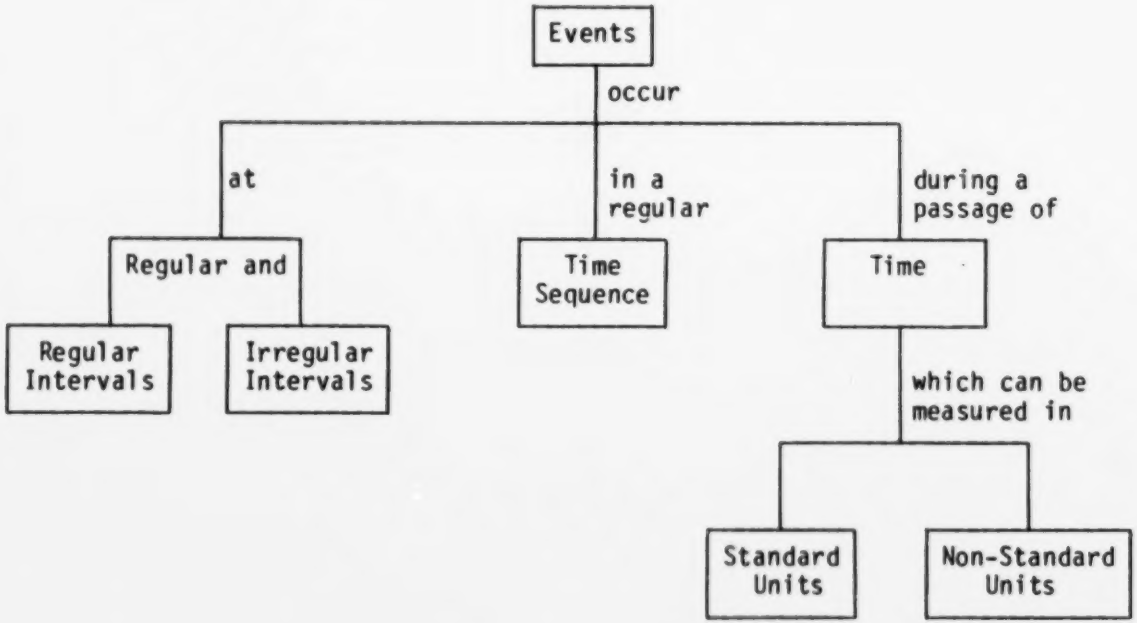
GRADE ONE

CHANGES IN MATTER AND ENERGY: PROPERTIES OF MATTER



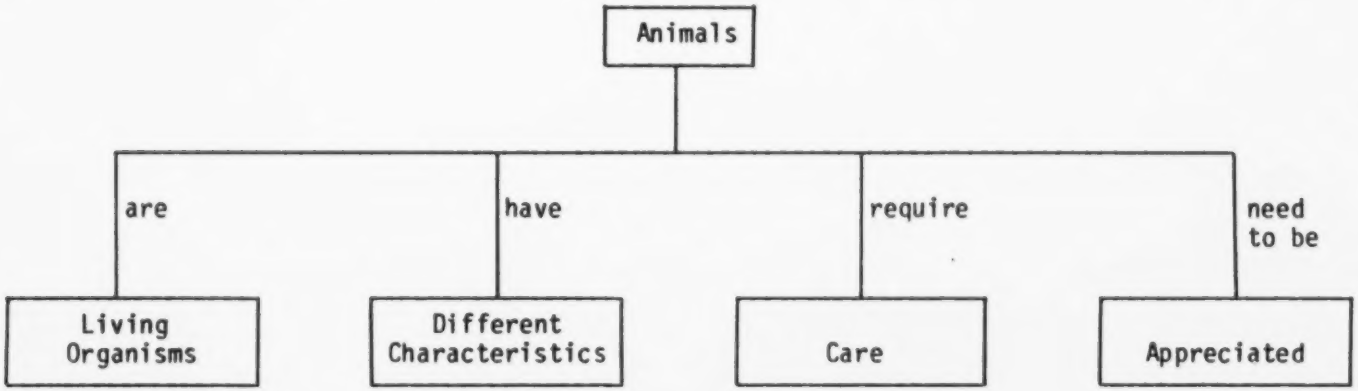
GRADE ONE

EARTH, SPACE AND TIME: COMPARING AND MEASURING EVENTS



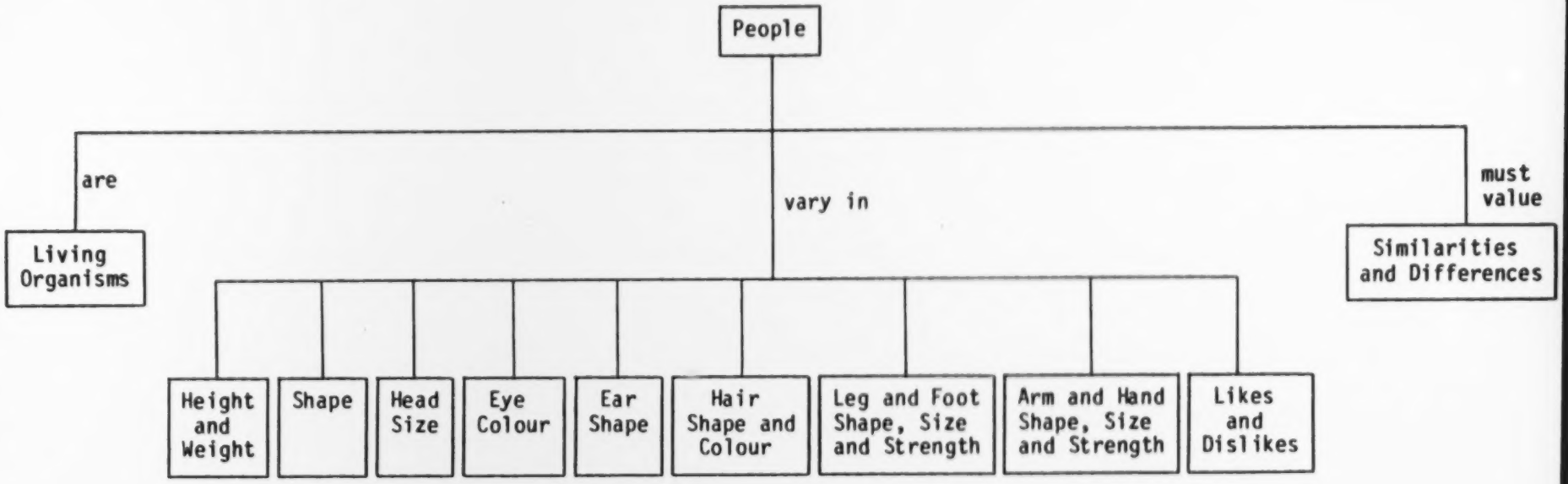
GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: ANIMALS ARE LIVING ORGANISMS



GRADE ONE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: PEOPLE ARE LIVING ORGANISMS



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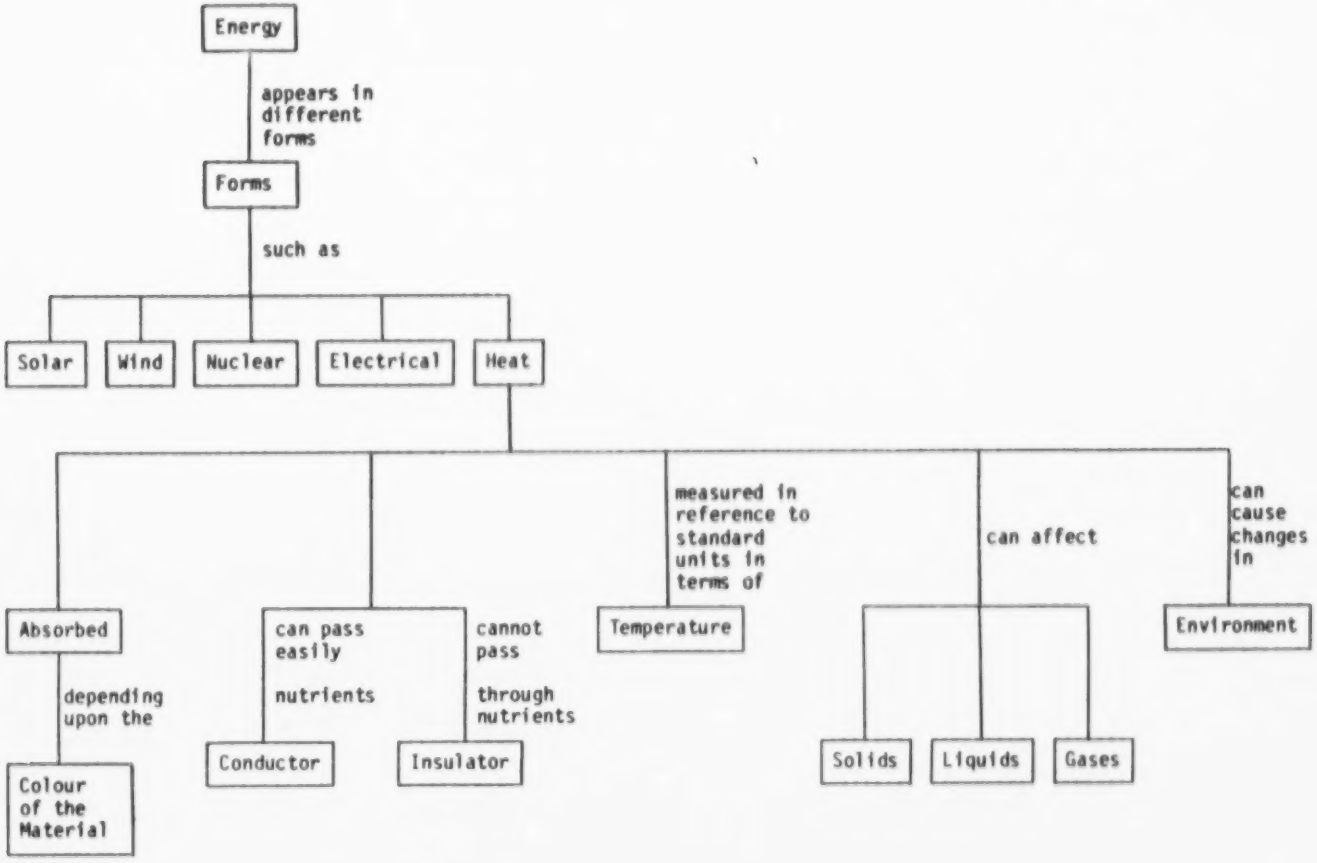
GRADE THREE

CHANGES IN MATTER AND ENERGY: ENERGY, HEAT, TEMPERATURE



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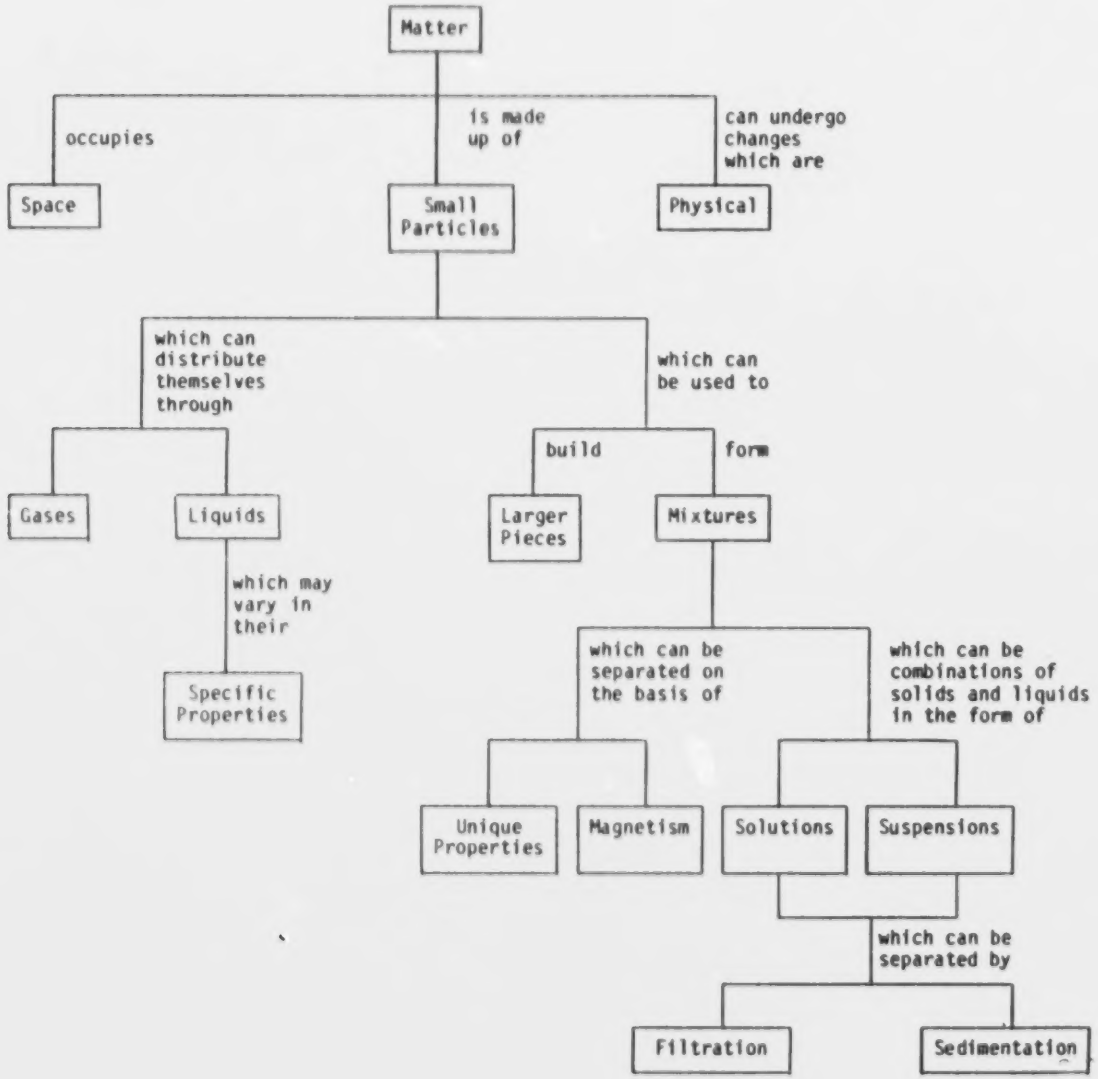
GRADE THREE

CHANGES IN MATTER AND ENERGY: CHANGES IN MATTER



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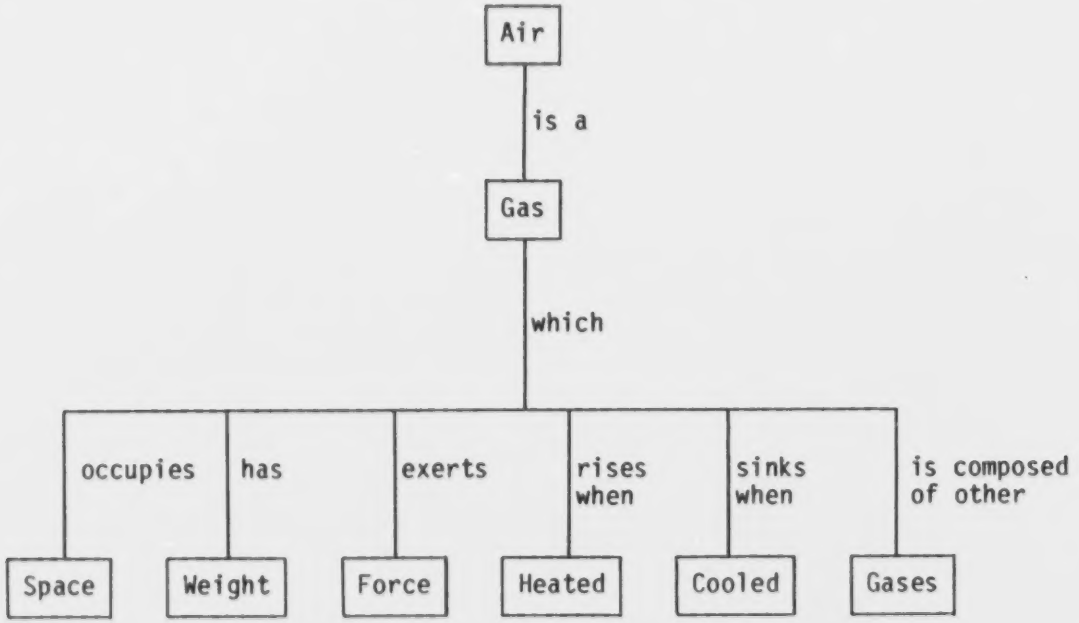
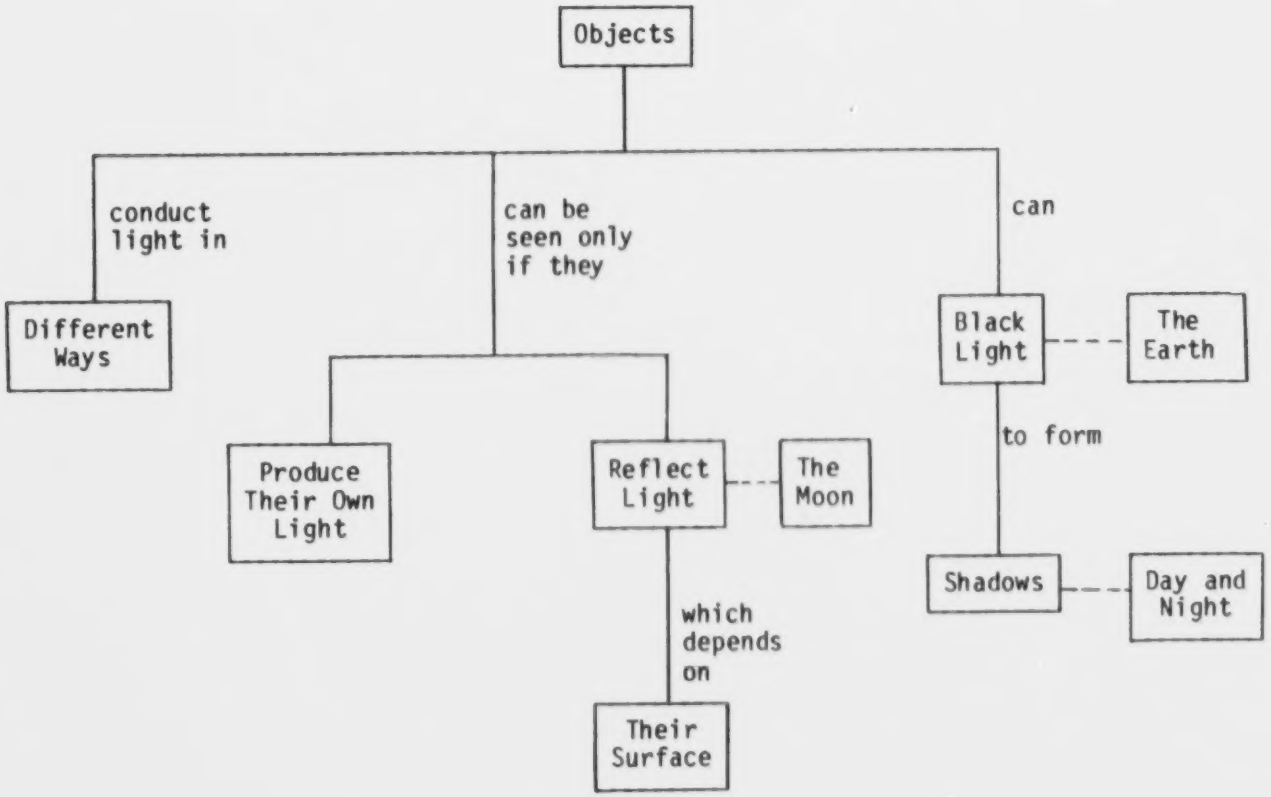
GRADE THREE

CHANGES IN MATTER AND ENERGY: AIR AND AIR PRESSURE



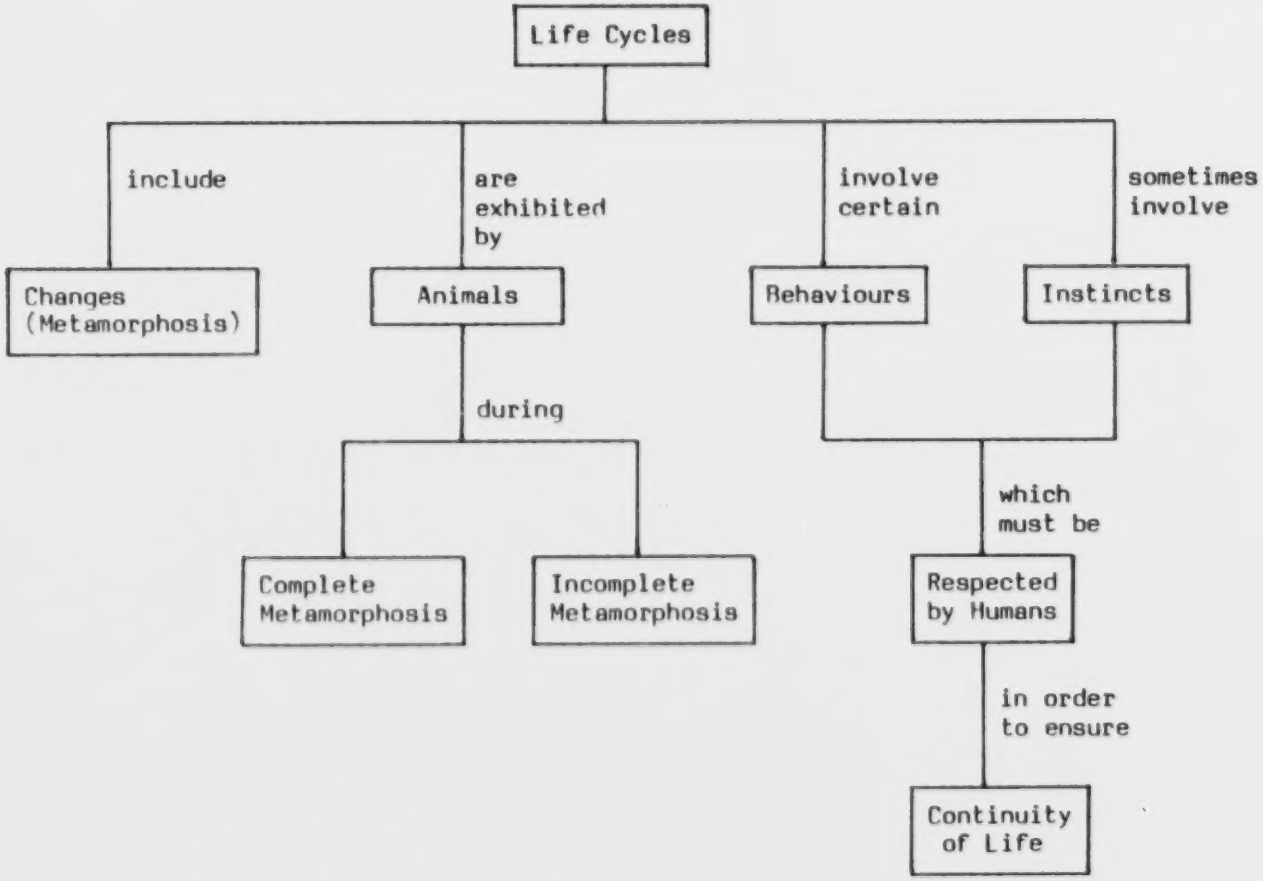
GRADE THREE

EARTH, SPACE AND TIME: THE EARTH, SUN AND MOON



GRADE THREE

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIFE CYCLES



MATERIALS LIST

This is a suggested minimum list for the K-4 Science program. Many other items should be readily available at school or in the home. Teachers should be advised to review the units so that locally available material may be obtained in advance. A petty cash fund needs to be available in order that purchases may be made on an ongoing basis.

Basic Materials

- pop bottles (glass)
  (plastic - 500 ml, 1 litre, 2 litre)
- plastic containers and lids in all sizes
- egg cartons
- trays of assorted sizes
- cloth of all textures, colors, and materials
- nylons and panty hose
- newspaper
- jars of all sizes with lids
- tin cans of all sizes
- pine cones, bark, twigs
- popcorn kernels
- food colouring
- a variety of woods
- a variety of sandpaper
- coins
- milk cartons
- alka seltzer tablets
- sponges
- assortment of food and cooking items
- crackers, orange juice crystals, detergent, spaghetti, macaroni, salt, sugar, sugar cubes, baking powder, vinegar, flour, syrup, cornstarch, vegetable oil, molasses, dish detergent.
- popsicle sticks
- large and small graph paper
- wax (paraffin wax)
- vegetable oil, molasses, dish detergent
- an assortment of string
- an assortment of wool
- waxed paper
- aluminum foil
- plastic wrap
- paper towels
- kettle
- pie plates styrofoam and tin
- insulated wire (copper)
- toilet rolls
- gravel
- sand
- ping pong balls
- cardboard of all sizes and thickness
- plastic combs
- tooth picks
- cereals
- cotton balls
- threads
- an assortment of nails
- fossils (plastic models can be purchased)
- pulleys single and double
- index cards
- pictures
- balloons
- latex gloves
- straws
- spoons
- elastic bands
- thumbtacks
- paper clips

- straight pins
- candles
- dry cells
- light bulbs (miniature)
- scale (kg)
- magnets
- magnifying glasses
- fixed pan balance
- aquarium
- variety of seeds
- plasticine
- meter stick
- tape
- tape measure
- weights (g)
- graduated cylinder
- beakers
- medicine droppers
- test-tubes
- thermometers
- rubber stoppers
- corks
- glass tubing
- filter paper
- marbles
- baggies
- paper towels
- mirrors
- steel wool
- washers
- styrofoam cups
- paper cups
- clock (with second hand)
- markers
- drinking straws

SPECIFIC MATERIALS

Kindergarten

1. attribute blocks
2. terrarium
3. bulbs (for planting)
4. soil

Grade One

1. attribute blocks
2. logic sets (trees, vehicles, etc.)
3. egg beater
4. metronome (if available)
5. graph paper
6. bathroom scale

Grade Two

1. graph paper
2. 30 cm. ruler
3. flashights (different sizes)
4. light bulb and socket
5. chart paper

Grade Three

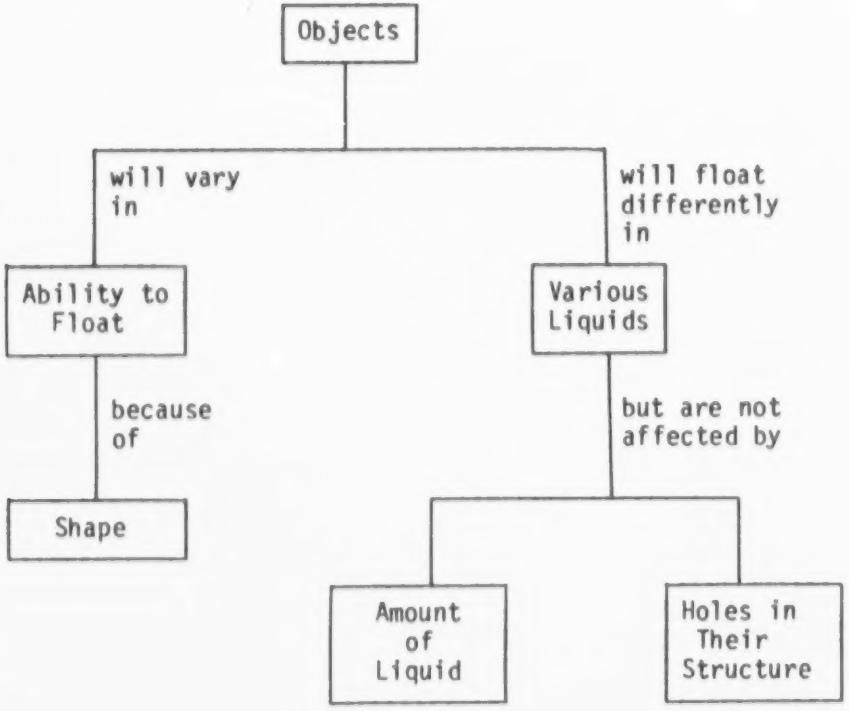
1. light bulb and socket
2. ball and ring apparatus
3. rubber tubing
4. meal worms
5. beetles
6. earthworms
7. glass flask
8. wax (paraffin)

Grade Four

1. nichrome wire
2. sockets (for miniature light bulbs)
3. alligator clips
4. fine steel wool
5. tuning fork
6. slinky
7. ticking clock
8. microscope slides
9. cover slips
10. microscope
11. prepared animal cells
12. iodine
13. skeleton set

GRADE TWO

CHANGES IN MATTER AND ENERGY: FLOTATION: A PROPERTY OF MATTER



GRADE TWO

TITLE: CHANGES IN MATTER AND ENERGY: FLOTATION: A PROPERTY OF MATTER

RATIONALE: Through the use of process skills, hands-on investigation, children will understand the concept of flotation, and the study will provide a basis for future study on weight and density.

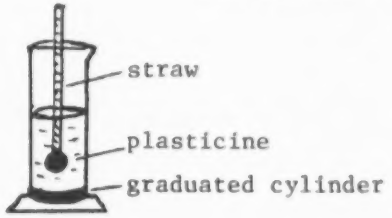
MAIN CONCEPT(S): Solids vary in the ways that they float. Not all solids float the same in different liquids. The shape of a material affects its ability to float.

Note: This unit integrates well with math units.

* Refers to problem-solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Solids will vary in the ability to float.	a) Predict which objects will float.	Have students make predictions, then have them test objects such as metal, wood, plastic, styrofoam, wax (crayon), glass, cork.
	b) Classify objects that will float.	Make a sink/float chart with predictions and results.
	c) Predict if cutting or breaking objects will affect their ability to float.	Cut or break the objects used above. Have the students test and list results.

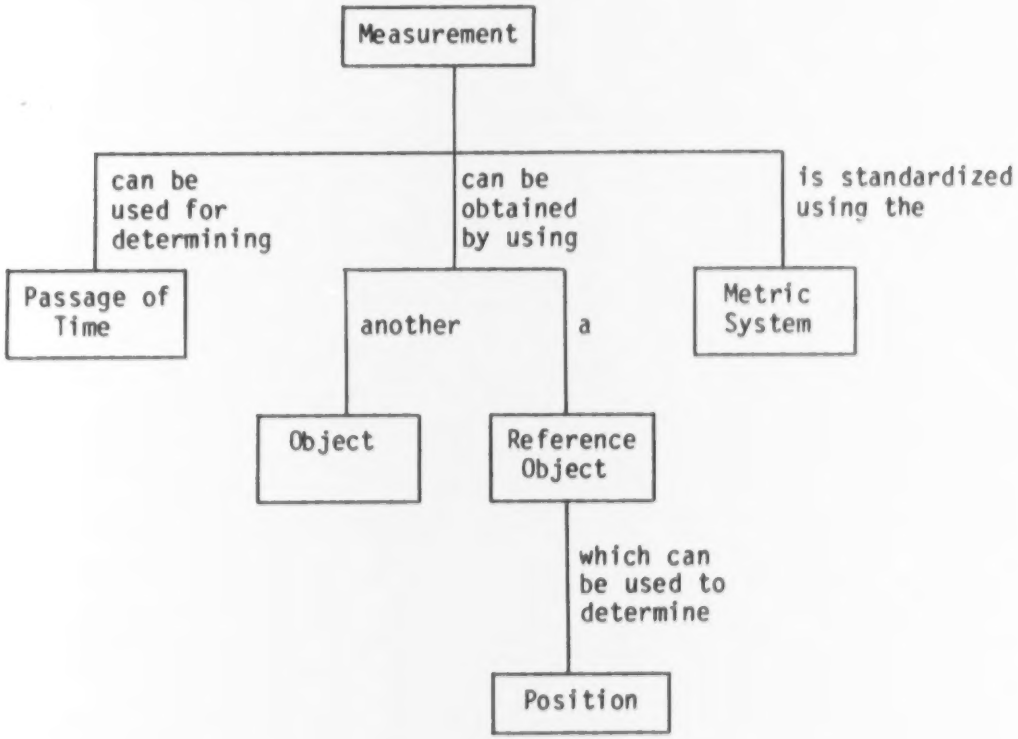
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	d) Infer that some solids will float in water.	
	e) Develop curiosity about natural events.	By allowing hands-on experience with this unit children develop curiosity about natural events such as flotation. ENRICHMENT Use plastic Diene's Blocks for sink and float experiments. e.g. will one flat hold one hundred units.
2. Objects will float differently in various liquids.	a) Observe that different liquids will affect the way an object floats.	Use wide jars with equal depths of water, vegetable oil, glycerin, molasses, vinegar, salt water. SAFETY Do not taste. Wash objects in soap and water between liquid transfers. Rinse them thoroughly.
	b) Infer that some liquids do not allow objects to sink as easily.	NOTE: Some oils are thicker than water, but are actually less dense. Use molasses or corn syrup. Try them when they are cold and at room temperature.
	c) Observe that objects sink at different rates.	Test and record results.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	e) Construct a simple hydrometer to show that the same object will float differently in different liquids.	Use the ordered liquids from 2 d) to determine the levels at which the straws will float. 
3. The shape of a material affects its ability to float.	a) Design and construct a shape out of oil-based plasticine that will float.	Use warm water so plasticine does not get brittle and crumble. Use an adequate depth of water. Have students use a simple balance to measure out 200 grams of plasticine.
	b) Predict the weight the shape will hold. Record predictions. Test, and graph results.	Use beads, paper clips, standard weights and marbles.
	c) Predict and test shapes for the amount of weight they will hold on the basis of: i) length ii) depth iii) thickness of plasticine iv) size (large/small)	

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. The amount of water does not affect the ability to float.	a) Predict whether objects that previously floated would still float if the water was: i) deeper ii) the same depth as i), but in a wider container. b) Infer that neither the depth nor the amount of water affects the ability to float.	Chart predictions
5. Materials that float regardless of their shape are not affected by putting holes in them.	a) Predict and test what putting holes in a material will do to its ability to float. b) Infer that a material that floats will do so even if full of holes. c) Design and construct boats which will float, test their ability to float. Appreciate the need for supportive evidence.**	Use cork, candle, styrofoam, apple, sponge.

GRADE TWO

EARTH, SPACE AND TIME: MEASURING TIME, OBJECTS AND POSITION



GRADE TWO

TITLE: EARTH, SPACE, AND TIME: MEASURING TIME, OBJECTS AND POSITION

RATIONALE: Through the use of process skills, children will further develop the ability to use standard units to measure the passage of time, distance and position.

MAIN CONCEPT(S): The size, position and duration of events can be measured by standard and non-standard units. The metric system is a world wide standard system.

* Refers to problem solving
** Refers to STS
*** Refers to SDS

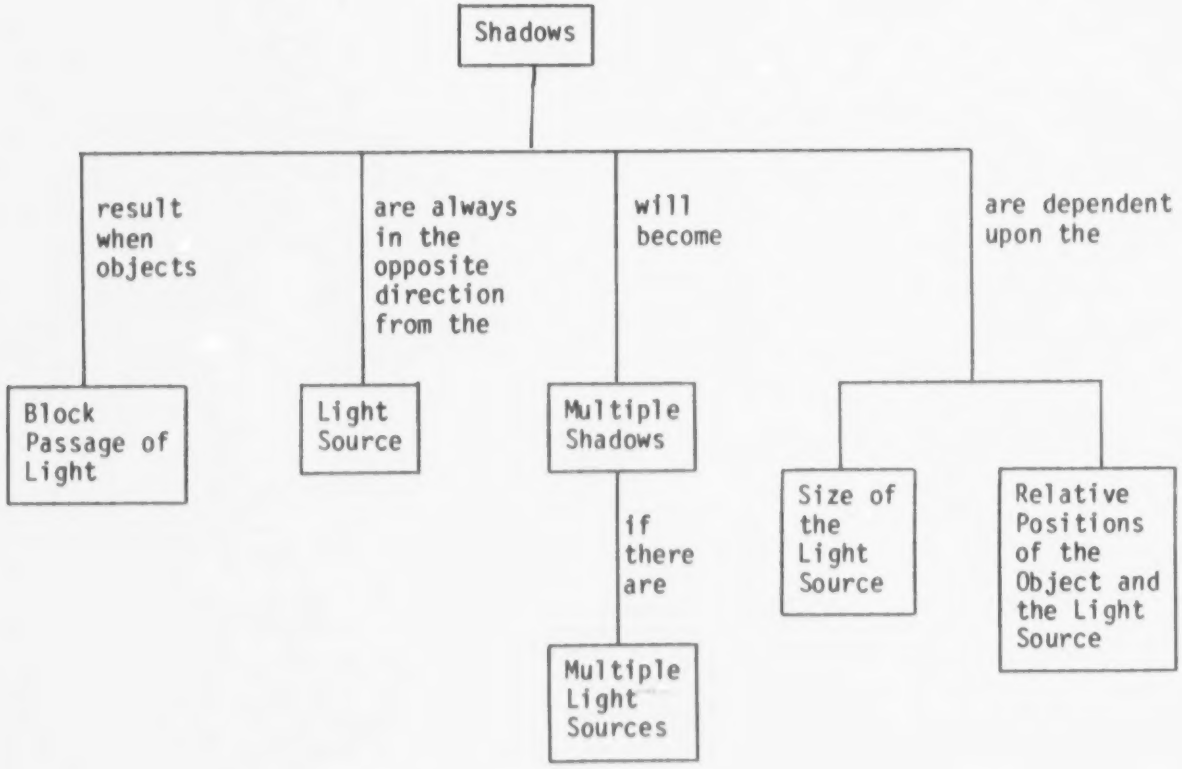
CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The students should be able to:	
1. The passage of time can be measured in standard units: hours, minutes, seconds.	a) Observe intervals of minutes and seconds on a standard clock.	Use a standard sweep-hand clock that has a second hand.
	b) Observe the relationship between the passage of minutes and seconds.	Ask students to suggest ways of determining a second, such as water dripping or blinking an eye. Have them practice "one thousand and one."
	c) Estimate duration of time in minutes and seconds.	Make a pendulum that swings 60 times every minute. Measure the duration of events with the pendulum.
	d) Describe the appropriate unit used to time a regular event.	Have students suggest events lasting one minute. Try a 33 speed record player. Tape a reference point and count.
	e) Classify events which would be timed in hours, minutes or seconds.	Discuss activities in which students may be involved, e.g., swimming, riding the bus, lunch, races, trips.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	f) Operationally define a second and a minute.	The student should be able to say that the time it takes for a person to say "one thousand and one," is a second of time. The student should be able to say that the time it takes for a person to say "one thousand and one" sixty times is a minute of time.
2. One object can be used to measure another. It is more satisfactory to use an acceptable standard.	a) Measure a variety of objects, using a basic reference unit (non-standard).	Have students make paper strips which are of two pencil lengths and then measure several articles with the strips. Compare results. Discuss the need for standard size of unit. Note: If students have had ample exposure to non-standard units of measurement (math, grade 1 science) only a short review may be necessary.
	b) Select appropriate units to measure large and small objects. Describe why that some units are more satisfactory to use in relation to size of an object.	Measure books with paper clips and then a ruler. Measure the length of a room using a 30 cm. ruler and than a metre stick.
3. The metric system is a world-wide standard system.	a) Introduce metres and centimetres.	Using metric tape measures, demonstrate measurement of objects. They can suggest and record estimates before you measure the objects. (Measure to the nearest whole).
	b) Estimate in the metric system and practice using these appropriately to measure objects.	Have students select three or four objects the size of which they want to estimate in metres or centimetres. Animate or inanimate objects may be used as well as objects found inside and outside the classroom. Students may make reports on those objects which they have selected.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	c) Observe how society uses the metric system.	Show pictures of a football field, highway, etc.
	d) Appreciate the need for standard units.	Discuss need for standard units in clothing, replacing parts on a bicycle, etc.
4. Objects can be located and measured with respect to a reference object.	a) Demonstrate the 6 principal directions in space relative to an object (front, back, above, below, right, left).	Select a reference object. Place another object nearby and have the students measure the distance away and state the direction quantitatively, e.g., 10 cm behind or 4 cm to the right.
	b) Measure the distance of an object from a reference point, using standard units.	Show the students pictures of a lost boat, bicycle or any other object and ask them how they would help find it and tell where it was.
	c) Describe the position of an object relative to a reference point.	Have students act out directions with respect to an object.

GRADE TWO

EARTH, SPACE AND TIME: LIGHT AND SHADOWS



GRADE TWO

TITLE: EARTH, SPACE AND TIME: LIGHT AND SHADOWS

RATIONALE: Through the use of process skills, children will develop an understanding of the relationship between objects, light and shadows.

MAIN CONCEPT(S): The structure and position of an object can be determined from the shadows cast by an object.

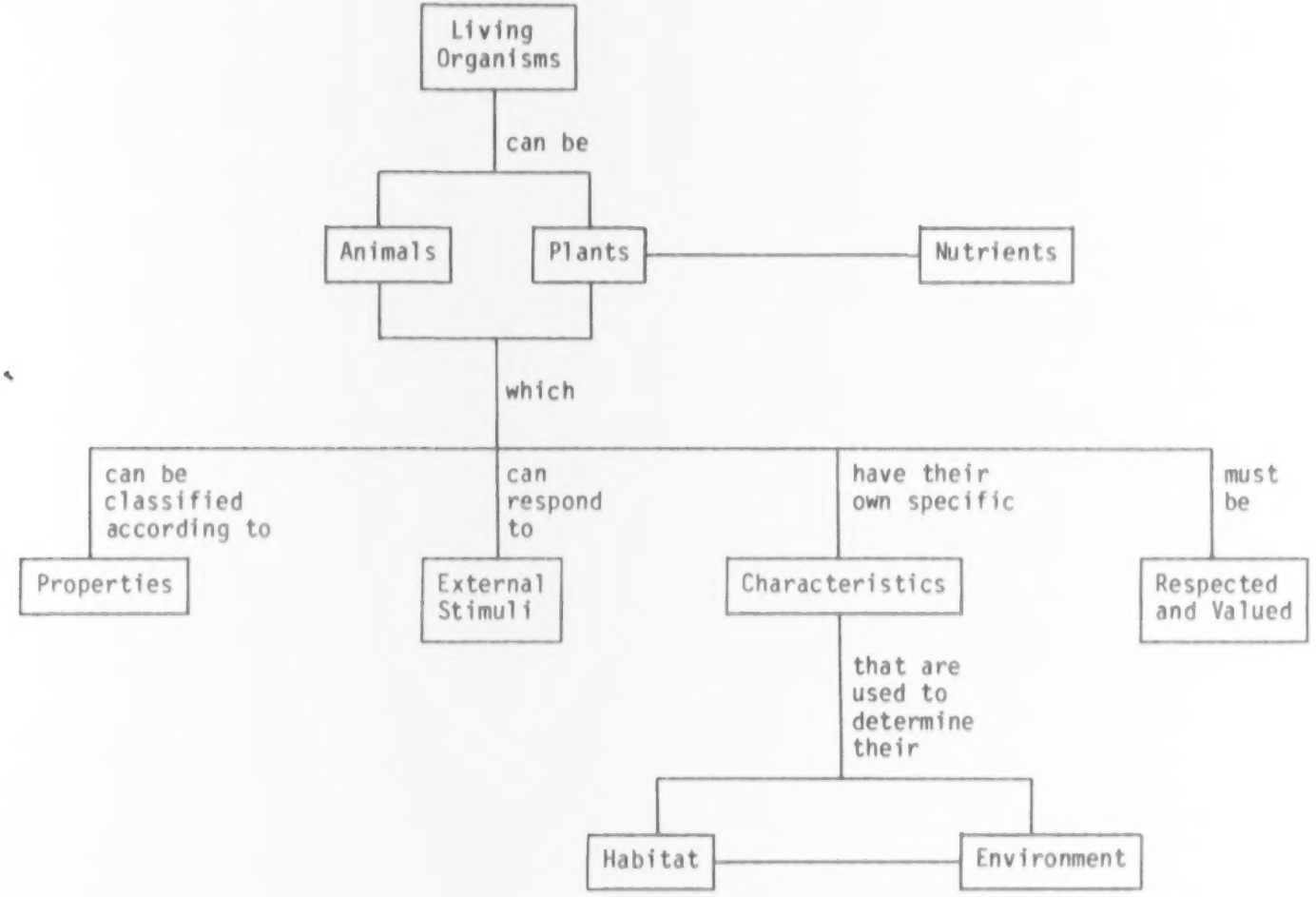
* Refers to problem solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	The student should be able to:	
1. A shadow results when an object blocks the passage of light.	a) Observe the elements necessary to produce a shadow.	SAFETY Students should be warned to never look directly at bright lights. Use matches, light bulbs, candlesticks, film projectors, place objects in front of the beam, producing clear shadows on the wall. Try making shadows with hands. Make silhouettes of each student.
	b) Infer the shape of an object by looking at its shadow.	Try to guess the type of object on the basis of the shadows produced.
2. The light source that causes a shadow to be cast is always in the opposite direction of the shadow.	a) Predict the direction a shadow will fall when a light source is placed in various positions.	Look at pictures that show objects and their shadows. Have students determine where the light is coming from in each picture, and what kind of day it is.
3. Multiple light sources provide multiple shadows.	a) Infer the number of light sources by observing the number of shadows.	Set up a pencil vertically on a wad of plasticine. Cast a shadow with a flashlight, then with several flashlights.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
4. The size of the light source determines the type of shadow.	a) Observe that the size of the light source affects the type of shadow produced.	Use a large flashlight and a small one, or a flashlight and an overhead projector.
5. The size, shape and sharpness of the shadow is dependent upon the relative positions of the object and the light source.	a) Observe that the size, shape and sharpness of a shadow varies according to the position of the light and object.	Manipulate several objects and cast shadows with them: ruler, ball, paper towel roll, cube, scotch tape roll. Provide a small group with a doll and a flashlight. Experiment with making long and short shadows, making shadows disappear and making shadows on all sides of the doll. Shine a flashlight on a stick so that its shadow is cast on the wall. Change the position of the flashlight and compare the shadows. ENRICHMENT Have students use a screen and light source. Have them predict what will happen if the screen is curved. Test.
	b) Predict the size and shape of a shadow when an object is exposed to a light source.	

GRADE TWO

INTERDEPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING ORGANISMS IN THE ENVIRONMENT



GRADE TWO

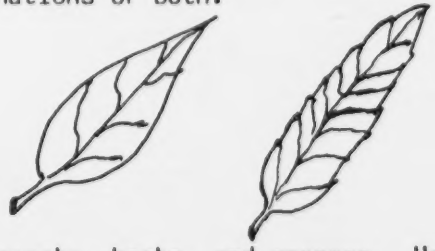
TITLE: INTERPENDENCY AND INTERACTION AMONG ORGANISMS: LIVING ORGANISMS IN THE ENVIRONMENT

RATIONALE: Through the use of process skills, children will recognize the effect the environment plays in the placement of animals and plants in the world, and how people can affect the environment.

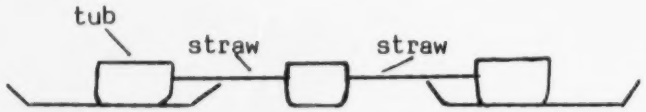
MAIN CONCEPT(S): Living organisms exhibit unique properties. These characteristics may help determine their location within the environment.

* Refers to problem-solving
** Refers to STS
*** Refers to SDS

CONCEPTUAL STRUCTURE	OBJECTIVES •	ACTIVITIES, REFERENCES
	The student should be able to:	
1. Living organisms can be classified according to properties:	a) Classify animals according to arbitrary groups.	Group animals according to the students' categories, i.e., farm animals, pets, zoo animals, etc.
i) animals	b) Identify observable properties unique to the six following animal groups: i) mammals ii) insects iii) birds iv) amphibians v) reptiles vi) fish	List the properties under the names of the six groups.
	c) Research and record data on individual animals in each of the six groups.	Have books available from the library for group or individual projects.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
	d) Operationally define the six animal groups.	After researching certain properties of the six groups will be evident. These properties should be used to form definitions which the students understand.
	e) Communicate information on individual animals.	Have a sharing time for each student to present projects.
	f) Classify animals according to the six animal groups.	Use pictures of animals from each animal group and classify on a wall chart or as a board game.
ii) plants	g) Identify observable properties of plant structures such as: i) leaves ii) seeds/fruit iii) stems iv) roots	Using a simple hand lens, examine house plant and garden plant structures.
	h) Identify and classify the differences in the structure of leaves.	Make leaf rubbings to show vein patterns and edge patterns. Make leaf silhouettes. Look for alternate and opposite vein patterns and combinations of both.
	i) Identify and classify the differences in the structure of seeds/fruit.	
	j) Identify and classify the differences in the structure of stems.	
	k) Identify and classify the differences in the structure of roots.	Use carrots, beets, and grasses. Have students observe a root bound plant, i.e., a house plant which requires repotting.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
2. Living organisms respond to external stimuli.	a) Observe how living organisms react to stimuli such as touch, sound, light.	Watch a shamrock plant close at night. Observe plant growth in relation to light. Discuss what happens to insects at night when a light is on. Observe an earthworm's reaction when it is exposed to light. Discuss pets reactions to different stimuli.
	b) Identify and classify the responses that plants make to seasonal changes.	Observe how some trees drop leaves in the fall. Discuss how maple syrup is gathered. Plant tulip bulbs and keep them in a cold dark room (or fridge) for six weeks - observe their behaviour when they are brought back into the classroom.
	c) Identify and classify the responses that animals make to seasonal changes.	Discuss hibernation and migration. ENRICHMENT If ants are available, this activity may be carried out. Make holes in 3 margarine tubs. Place one tube in each baking pan and one between them. Join the tubs by sticking plastic drinking straws into the holes. The straw end should stick out 2 cm. Glue any spaces around the straws. Fill the tubs with soil, to the level of the straws. Place sweet food such as sugar cake crumbs into the 2 end tubs. Place the ants in the middle tubs. Cover all tubs with plastic wrap. Observe the ants for 15 minutes. Pour hot tap water into one baking pan and label hot. Put ice-cold water in the other pan and label it cold. Record the water temperature. Predict and observe the ants for 15 minutes recording their movement.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
		Record the water temperature again. Discuss the effect of temperature on ants' feeding habits.
		
3. Humans can affect the environment.	a) Identify and infer some responses which living objects make to environmental changes produced by humans.**	List environmental hazards caused by man, such as smoking. Look at litter. Discuss how to look after trees on streets and in yards.
	b) Recognize people's impact on their environment, and the need for the care of it.**	Discuss.
4. Plants require nutrients. They obtain them from the water, air, and soil. Green plants require light to make food.	a) Observe and describe what happens to plants when placed in hot/cold temperatures.*	Place one plant in the freezer, one in the fridge and one in a closet. Observe how temperature affects plants.
	b) Review the effects of no light or water on plants.	Place two plants of the same kind in sunlight. Water only one. Place two plants of the same kind in the sun. Water both but cover one with a cardboard box.
	c) Observe and describe the effects of different soils on seed growth.	Plant radish or grass seeds in soil, clay, sand, peat moss, pebbles or marbles. Water each group the same amount.
5. The place where a group of the same kind of organisms lives is called a habitat.	a) Define habitat.	Discuss and define habitat and have students arrive at a possible definition of population.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES
6. Characteristics of plants and animals determine their location in the environment.	a) Observe that plants live in many different habitats.** ***	Choose tundra, deserts, grasslands, marshes, mountains, rain forests. Describe conditions which certain plants need, soil/tree; water/water lily. Transplant some plants into another environment and observe.
i) plants	b) Identify these habitats.	Choose a shrub or tree with leaves which are easily reached. Make cardboard patches. Attach "patches" to leaves, using paper clips. After 14 days, remove the cardboard and observe the light-coloured spot on each leaf where the cardboard deprived the leaf of light.
ii) animals	a) Observe that animals live in many different habitats.	List various habitats and discuss the animals that live there.
	b) Identify these habitats.	Make a list such as: tundra, city, desert, ocean, field, forest, mountains, etc.
	c) Predict effects on animals if moved from one habitat to another.* ***	For example, the polar bear in the Winnipeg Zoo. Research the habitat and habits of polar bears. Compare and contrast their natural environment and the one in Winnipeg. What can be done to meet their needs in Winnipeg? Discuss some of the problems these bears would have in captivity. Visit the polar bears in the zoo, if possible.

CONCEPTUAL STRUCTURE	OBJECTIVES	ACTIVITIES, REFERENCES

	BEAR	FROG	SEA GULL
FOOD	berries fish insects animals	insects	fish
WATER	water	water	water
SHELTER	vegetation	caves	sand dunes
SPACE	marshes ponds	hills valleys	ocean coast

	d) Record and relate the habitat to animals.**	Design the perfect cage for a certain type of animal.
7. People must respect and value the environment.	a) Describe the changes to plants and animals due to logging, dams, construction, etc.**	Use pictures/field trips to observe burned out areas, housing areas, pipelines, etc.
	b) Recognize that people must develop a respect for the environment.** ***	Discuss the effects of neglect on the environment and its implications for the future. Have students suggest ways they can promote this objective. Plan a bottle or can drive.

RESPONSE QUESTIONNAIRE FOR K-9 SCIENCE PROGRAM OF STUDIES

Please return this questionnaire by January 15, 1992 to the:

Science Consultant
Curriculum Services
Manitoba Education and Training
411-1181 Portage Avenue
Winnipeg, Manitoba R3G 0T3

Please respond to each question in the space provided. (Attach extra sheets if more space is required). Use the page references when making specific comments.

1. Does the guide provide you with sufficient information as to nature and scope of the science program?

_____

_____

2. Are you able to adequately cover the stated objectives within the available class time?

_____

_____

3. Are your students capable of achieving the objectives listed in the unit(s)?

_____

_____

4. Is there sufficient variety in the activities to allow all students to take part in the program?

_____

5. Which activities are too simple or too difficult for the intended grade level?

_____

_____

6. Which activities do not seem to work well?

_____

_____

...../2

7. Which activities require clearer directions?

_____

_____

8. Are there sufficient material resources in your school to enable you to adequately teach the program?

_____

_____

9. Is there difficulty in obtaining science materials in order to carry out the activities?

_____

10. Do the students enjoy or appreciate the program?

_____

_____

11. What are some specific features of the program with which you are pleased?

_____

_____

12. Within the framework of the revised program, please make suggestions which, in your opinion, may result in significant improvements.

_____

_____

_____

_____

_____

NAME: _____ SCHOOL: _____

GRADE: _____ PHONE: _____

THANK YOU FOR YOUR ASSISTANCE.